

Claims

What is claimed is:

- 1 1. A method for implementing automated electronic package
2 transmission line characteristic impedance verification comprising the steps
3 of:
4 generating a selected frequency coupled to a transmission line test
5 structure;
6 measuring an input impedance with an open-circuit termination and a
7 short-circuit termination on said transmission line test structure;
8 using said input impedance measured value for said open-circuit
9 termination and said short-circuit termination, calculating characteristic
10 impedance; and
11 comparing said calculated characteristic impedance with threshold
12 values for verifying acceptable electronic package transmission line
13 characteristic impedance.
- 1 2. A method for implementing automated electronic package
2 transmission line characteristic impedance verification as recited in claim 1
3 includes the steps of providing a pair of transmission line test structures
4 respectively implemented at a package level with a open-circuit termination
5 and a short-circuit termination.
- 1 3. A method for implementing automated electronic package
2 transmission line characteristic impedance verification as recited in claim 2
3 wherein the steps of measuring said input impedance with said open-circuit
4 termination and said short-circuit termination for said transmission line test
5 structure includes the steps of providing open-circuit impedance measuring
6 circuitry coupled to one of said pair of transmission line test structures; and
7 providing short-circuit impedance measuring circuitry coupled to another of
8 said pair of transmission line test structures.

1 4. A method for implementing automated electronic package
2 transmission line characteristic impedance verification as recited in claim 1
3 includes the steps of providing a single transmission line test structure
4 implemented at a package level and providing open-circuit and short-circuit
5 termination circuitry coupled to said single transmission line test structure.

1 5. A method for implementing automated electronic package
2 transmission line characteristic impedance verification as recited in claim 4
3 wherein the steps of measuring said input impedance with said open-circuit
4 termination and said short-circuit termination for said transmission line test
5 structure includes the steps of sequentially providing an open-circuit
6 termination and a short-circuit termination to said single transmission line
7 test structure utilizing said open-circuit and short-circuit termination circuitry.

1 6. A method for implementing automated electronic package
2 transmission line characteristic impedance verification as recited in claim 1
3 includes the steps of displaying a pass or fail result responsive to said
4 compared values.

1 7. Apparatus for implementing automated electronic package
2 transmission line characteristic impedance verification comprising:
3 a sinusoidal voltage source coupled to a transmission line test
4 structure for generating a selected frequency;
5 impedance measuring circuitry coupled to said transmission line test
6 structure for measuring an input impedance for an open-circuit termination
7 and a short-circuit termination;
8 characteristic impedance calculation circuitry coupled to said
9 impedance measuring circuitry for receiving said input impedance measured
10 values with said open-circuit termination and said short-circuit termination for
11 calculating characteristic impedance;
12 logic circuitry coupled to said characteristic impedance calculation
13 circuitry for comparing said calculated characteristic impedance with
14 threshold values for verifying acceptable electronic package transmission
15 line characteristic impedance; and
16 said sinusoidal voltage source, said impedance measuring circuitry,
17 said characteristic impedance calculation circuitry, and said logic circuitry
18 being implemented by a single integrated circuit device.

1 8. Apparatus for implementing automated electronic package
2 transmission line characteristic impedance verification as recited in claim 7
3 wherein said transmission line test structure includes a pair of transmission
4 line test structures respectively implemented at a package level with a open-
5 circuit termination and a short-circuit termination.

1 9. Apparatus for implementing automated electronic package
2 transmission line characteristic impedance verification as recited in claim 8
3 wherein said impedance measuring circuitry includes an open-circuit
4 impedance measuring circuitry coupled to one of said pair of transmission
5 line test structures; and a short-circuit impedance measuring circuitry
6 coupled to another of said pair of transmission line test structures.

1 10. Apparatus for implementing automated electronic package
2 transmission line characteristic impedance verification as recited in claim 7
3 wherein said transmission line test structure includes a single transmission
4 line test structure implemented at a package level and an open-circuit and
5 short-circuit termination circuitry coupled to said single transmission line test
6 structure.

1 11. Apparatus for implementing automated electronic package
2 transmission line characteristic impedance verification as recited in claim 7
3 includes a display coupled to said logic circuitry for displaying a pass or fail
4 result responsive to said compared values.

1 12. Apparatus for implementing automated electronic package
2 transmission line characteristic impedance verification as recited in claim 7
3 wherein said characteristic impedance calculation circuitry calculates said
4 characteristic impedance represented by:
5 $Z_o = (Z_{sc} \cdot Z_{oc})^{1/2}$
6 where Z_o represents said calculated characteristic impedance and Z_{oc} and
7 Z_{sc} represent said input impedance measured values for said open-circuit
8 termination and said short-circuit termination.

1 13. Apparatus for implementing automated electronic package
2 transmission line characteristic impedance verification as recited in claim 7
3 wherein said logic circuitry compares said calculated characteristic
4 impedance with threshold values for verifying acceptable electronic package
5 transmission line characteristic impedance represented by:

6 $Z_1 < Z_o < Z_2$

7 where Z_o represents said calculated characteristic impedance and Z_1 , Z_2
8 represent lower and upper threshold values for an electronic package
9 characteristic impedance specification.

1 14. Apparatus for implementing automated electronic package
2 transmission line characteristic impedance verification as recited in claim 7
3 wherein said transmission line test structure represents conductors on a card
4 and said single integrated circuit device is disposed on said card.

1 15. An electronic unit comprising:
2 a transmission line test structure; and
3 a single integrated circuit device for implementing automated
4 electronic package transmission line characteristic impedance verification;
5 said single integrated circuit device including:
6 a sinusoidal voltage source coupled to said transmission line test
7 structure for generating a selected frequency;
8 impedance measuring circuitry coupled to said transmission line test
9 structure for measuring an input impedance for an open-circuit termination
10 and a short-circuit termination;
11 characteristic impedance calculation circuitry coupled to said
12 impedance measuring circuitry for receiving said input impedance measured
13 values with said open-circuit termination and said short-circuit termination for
14 calculating characteristic impedance;
15 logic circuitry coupled to said characteristic impedance calculation
16 circuitry for comparing said calculated characteristic impedance with
17 threshold values for verifying acceptable electronic package transmission
18 line characteristic impedance.

1 16. An electronic unit as recited in claim 15 wherein said
2 transmission line test structure represents conductors on a card and said
3 single integrated circuit device is disposed on said card.

- 1 17. An electronic unit as recited in claim 15 wherein said
- 2 transmission line test structure represents conductors on a multi-chip
- 3 module and said single integrated circuit device is included in said multi-chip
- 4 module.